

# LONDON- WEST MIDLANDS ENVIRONMENTAL STATEMENT

## Volume 5 | Technical Appendices

CFA17 | Offchurch and Cubbington

**Data appendix (AG-001-017)**

Agriculture, forestry and soils

November 2013

# LONDON- WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 5 | Technical Appendices

CFA17 | Offchurch and Cubbington

**Data appendix (AG-001-017)**

Agriculture, forestry and soils

November 2013



Department  
for Transport

High Speed Two (HS2) Limited has been tasked by the Department for Transport (DfT) with managing the delivery of a new national high speed rail network. It is a non-departmental public body wholly owned by the DfT.

A report prepared for High Speed Two (HS2) Limited.

High Speed Two (HS2) Limited,  
Eland House,  
Bressenden Place,  
London SW1E 5DU

Details of how to obtain further copies are available from HS2 Ltd.

Telephone: 020 7944 4908

General email enquiries: [HS2enquiries@hs2.org.uk](mailto:HS2enquiries@hs2.org.uk)

Website: [www.hs2.org.uk](http://www.hs2.org.uk)

High Speed Two (HS2) Limited has actively considered the needs of blind and partially sighted people in accessing this document. The text will be made available in full on the HS2 website. The text may be freely downloaded and translated by individuals or organisations for conversion into other accessible formats. If you have other needs in this regard please contact High Speed Two (HS2) Limited.



Printed in Great Britain on paper  
containing at least 75% recycled fibre.

# Appendix AG-001-017

Environmental topic:	Agriculture, forestry and soils	AG
Appendix name:	Data appendix	001
Community forum area:	Offchurch and Cubbington	017

# Contents

<b>Appendix AG-001-017</b>	<b>1</b>
<b>1 Introduction</b>	<b>3</b>
<b>2 Soils and agricultural land classification surveys</b>	<b>4</b>
2.1 Background	4
2.2 Soils and land resources	5
2.3 Soil and land use interactions	7
<b>3 Forestry</b>	<b>20</b>
<b>4 Assessment of effects on holdings</b>	<b>21</b>
<b>5 References</b>	<b>23</b>

## List of figures

Figure 1: Methodology for calculating the severity of a droughtiness limitation to ALC grading (derived from MAFF, 1988)	11
--	----

## List of tables

Table 1: Bedrock and soil forming materials	6
Table 2: Soil associations	6
Table 3: Interpolated agro-climatic data	8
Table 4: ALC grade according to soil wetness – mineral soils (From Table 6 of ALC Guidelines, October 1988) <sup>10</sup>	9
Table 5: Worcester Association (431)	13
Table 6: Wick Association (541r)	14
Table 7: Hodnet Association (572c)	15
Table 8: Whimble 3 Association (572f)	16
Table 9: Brockhurst 1 Association (711b)	17
Table 10: Salop Association (711m)	18
Table 11: Fladbury 1 Association (813b)	19
Table 12: Area of woodland within the study area and construction boundary	20
Table 13: Summary of assessment of effect on holdings	21

# 1 Introduction

1.1.1 The agriculture, forestry and soils appendices for the Offchurch and Cubbington community forum area (CFA17) comprise:

- Soils and agricultural land classification surveys (Section 2);
- Forestry (Section 3); and
- Farm impact assessment summaries (Section 4).

1.1.2 Maps referred to throughout the agriculture, forestry and soils appendix are contained in the Volume 5 agriculture, forestry and soils map book.

## 2 Soils and agricultural land classification surveys

### 2.1 Background

- 2.1.1 The soils and agricultural baseline conditions reported have been established from desktop studies and site surveys.
- 2.1.2 Information gathered by desktop studies has related primarily to the identification of soil resources in the study area, the associated physical characteristics of geology, topography and climate which underpin the assessment of agricultural land quality, and the disposition of land uses. The main sources of information have included:
- National Soil Map<sup>1</sup>;
  - Soils and Their Use in Midland and Western England<sup>2</sup>;
  - Soils in Warwickshire<sup>3</sup>;
  - Solid and superficial deposits from the Geology of Britain viewer<sup>4</sup>;
  - Gridpoint meteorological data for Agricultural Land Classification of England and Wales<sup>5</sup>;
  - Provisional Agricultural Land Classification of England and Wales (1:250,000)<sup>6</sup>;
  - Likelihood of Best and Most Versatile Agricultural Land (1:250,000)<sup>7</sup>;
  - Agri-environment schemes<sup>8</sup>;
  - Aerial photography from Google Earth; and
  - On-site soil and Agricultural Land Classification surveys.
- 2.1.3 Information gathered by field survey<sup>9</sup> has related to the enhancement of desk-based information on soils and agricultural land quality, and the engagement with landowners and tenants to establish the nature and extent of agricultural, forestry and related rural enterprises.
- 2.1.4 Field and other data were interpreted using the MAFF's 1988 Revised Guidelines and Criteria for Grading the Quality of Agricultural Land<sup>10</sup>.

---

<sup>1</sup> Cranfield University (2001), *The National Soil Map of England and Wales 1:250,000 scale*. Cranfield University: National Soil Resources Institute.

<sup>2</sup> Soil Survey of England and Wales (1984). *Soils and Their Use in Midland and Western England*. Harpenden.

<sup>3</sup> Whitfield, William (1974), *Soils in Warwickshire I*; SP36 (Leamington Spa). Rothamsted Experimental Station.

<sup>4</sup> British Geological Survey. <http://bgs.ac.uk/geologyofbritain/home/html>.

<sup>5</sup> Meteorological Office (1989), *Gridpoint Meteorological data for Agricultural Land Classification of England and Wales and other Climatological Investigations*.

<sup>6</sup> Ministry of Agriculture, Fisheries and Food (1983), *Agricultural Land Classification of England and Wales (1:250,000)*.

<sup>7</sup> Department for Environment, Food and Rural Affairs (2005), *Likelihood of Best and Most Versatile Agricultural Land (1:250,000)*.

<sup>8</sup> Multi-Agency Geographical Information for the Countryside (MAGIC) available on line @ [www.magic.gov.uk](http://www.magic.gov.uk).

<sup>9</sup> Hodgson, J.M. (1997), *The Soil Survey Field Handbook*. Soil Survey Technical Monograph no. 5, Silsoe.

<sup>10</sup> Ministry of Agriculture, Fisheries and Food (1988), *Agricultural Land Classification of England and Wales – Revised guidelines and criteria for grading the quality of agricultural land*.

- 2.1.5 Information obtained from farm impact assessment interview surveys has been taken as a factual representation of local agricultural and forestry interests and has not been subject to further evaluation.

## 2.2 Soils and land resources

- 2.2.1 This part of the technical appendix describes the findings of a desktop study and targeted soil survey and Agricultural Land Classification (ALC) survey that identified existing soil and agricultural land resources in the study area.

- 2.2.2 The location and extent of different soil types and agricultural land in the different ALC grades are influenced by topography and drainage, and by geology and soil parent materials, which are described in turn in the following sections. This section then provides a description and distribution of the main soil types encountered along the study corridor.

### Topography and drainage

- 2.2.3 The proposed route passes into the south-east of the study area across the valley containing the Grand Union Canal. The character of the area is one of dissected rolling topography at 55m to 100m above Ordnance Datum (AOD). The route crosses two low plateaux or ridges of glacial deposits: east and south-east of Offchurch; and east of Cubbington. Between these is the valley of the meandering River Leam. In the north-west, beyond Coventry Road, the ground begins to fall away towards the River Avon.
- 2.2.4 The River Leam flows south-westwards for 2km through a broad valley towards the River Avon between Warwick and Royal Leamington Spa. It is fed along its course by mainly short tributary streams.

### Geology and soil parent materials

- 2.2.5 Superficial geology is complex and influenced by the topography along the Proposed Scheme. The Proposed Scheme passes through:
- Alluvium, comprising clay, silt, sand and gravel, and River Terrace Deposits associated with major surface watercourses;
  - an area of Head Deposits, comprising poorly sorted and poorly stratified clay, silt, sand and gravel, to the east of Welsh Road Farm;
  - sand and gravel underlie the study area at the Offchurch railway cutting and a further two bands of sand and gravel are present towards the southern and northern extents of Cubbington Wood; the sand and gravel include lenses of silt and clay; and
  - intermittent Glacial Deposits comprising clays and sand and gravel are present immediately to the south of Offchurch Greenway and to the north and south of Cubbington Wood.
- 2.2.6 The Mercia Mudstone Group underlies the majority of the Proposed Scheme in this study area and is described as red and green-grey mudstones and subordinate siltstones with widespread thin beds of gypsum/anhydrite. Overlying subsidiary formations, namely the Blue Anchor Formation and Arden Sandstone Formation,



outcrop towards the south of the Proposed Scheme. The Bromsgrove Sandstone Formation underlies the Proposed Scheme immediately to the north of the route section.

- 2.2.7 A list of geological strata occurring within the study area is provided in age order in Table 1 and shown on Map WR-02-017 (Volume 5).

Table 1: Bedrock and soil forming materials

Formation	Composition/soil parent material
<b>Superficial deposits</b>	
Thrussington Member	Diamicton, Clay with flints
Baginton Sand and Gravel	Sands and gravel with lenses of silt and clay
Dunsmore Gravel	Flinty gravel with lenses of coarse sands
Wolston Sand and Gravel Formation	Clays, sands and gravels
Alluvium	Clay, silt, sand and gravel
Head	Comprising poorly sorted and poorly stratified clay, silt, sand and gravel
<b>Bedrock</b>	
Mercia Mudstone Group	Comprises mudstones, siltstones and sandstone
Bromsgrove Sandstone Formation	Sandstones and occasional mudstones

## Description and distribution of soil types

- 2.2.8 The characteristics of the soils are described by the Soil Survey of England and Wales that accompanies the National Soil Map. More detailed published information is also available for part of the study area (Soils in Warwickshire I; SP36 – Leamington Spa). The soils are grouped into soil associations of a range of soil types (soil series) and are summarised in Table 2, and their distribution is shown on Map AG-02-17.

Table 2: Soil associations

Soil association: code shown on Map AG-02-17	Soil association: name	Description	Wetness class
431	Worcester	Slowly permeable, non-calcareous and calcareous reddish clayey soils over mudstone with slight to moderate seasonal waterlogging; some similar non-calcareous clay loam over clayey soils	II-III
541r	Wick 1	Deep well drained sandy loam and sandy soils, locally over gravel; some similar soils affected by groundwater	I-II
572c	Hodnet	Reddish clay loam and sandy loam soils with slowly permeable subsoils and slight seasonal waterlogging; some similar well drained reddish clay loam soils	II
572f	Whimple 3	Reddish clay loam and silty clay loam over clayey soils with slowly permeable subsoils and slight seasonal waterlogging; some similar clayey soils on brows; slowly permeable seasonally waterlogged clay loam over clayey soils on lower slopes	II-III
711b	Brockhurst 1	Slowly permeable seasonally waterlogged reddish clay loam over clayey, with some similar soils with slowly permeable subsoils and slight seasonal waterlogging	III-IV

Soil association: code shown on Map AG-02-17	Soil association: name	Description	Wetness class
711m	Salop	Slowly permeable seasonally waterlogged reddish clay loam over clayey, clay loam and clayey soils, associated with clay loam over clayey soils with slowly permeable subsoils and slight seasonal waterlogging	II-IV
813b	Fladbury 1	Stoneless clayey soils with prominent mottles variably affected by groundwater	III-IV

2.2.9 The National Soil Map<sup>1</sup> shows seven principal soil types within this community forum area:

- Around Welsh Road, Offchurch, and south of Cubbington Wood the soils developed in the reddish Mercia Mudstone are of the Worcester association with typically reddish-clayey material passing to slowly permeable clay or soft mudstone. There are some similar clay loam over clay soils that have slight to moderate seasonal waterlogging and are in Wetness Classes (WC) III to IV<sup>11</sup>;
- Across lower slopes of the 1.5 km to 2 km wide Leam valley and through Offchurch east towards Burnt Heath, occur sandy loams and sandy soils of the Wick 1 association; the soils, locally over gravel, are mostly well drained but have slight seasonal waterlogging where affected by groundwater (WC I to II);
- Soils of the Hodnet and Whimple 3 associations are mapped on a range of thin drifts over mudstone; they consist of reddish loams over slowly permeable clayey lower subsoils with slight to moderate seasonal waterlogging (WC II to III);
- On lower slopes north-west of the Leam are seasonally waterlogged soils of the Brockhurst 1 association developed over mudstone (WC III, rarely IV); similar soils of the Salop association that have slowly permeable subsoils in till occur on high ground in and around Cubbington Wood (WC III, rarely IV); and
- On the floodplains of the River Leam and valley occupied by the Grand Union Canal occur clayey, non-calcareous alluvial soils of the Fladbury 1 association (WC III to IV).

## 2.3 Soil and land use interactions

### Agricultural land quality

2.3.1 A review of available ALC information has been undertaken to ascertain the land quality within the study area. The review also sought to identify the extent of existing detailed post-1988 ALC information to ensure that surveys are not repeated unnecessarily, but there are none in this CFA.

<sup>11</sup>The Wetness Class (WC) of a soil is classified in Appendix II of Hodgson, J.M. (1977) The Soil Survey Field Handbook. Soil Survey and Land Research Centre, Technical Monograph No.5, according to the depth and duration of waterlogging in the soil profile and has six bands ranging from Wetness Class I (well drained) to Wetness Class VI (permanently waterlogged).

- 2.3.2 ALC has been assessed from available information in the form of detailed (1:25,000 scale) soil mapping<sup>3</sup> and of archived Soil Survey records obtained from the National Soil Resources Institute NSRI at Cranfield University.

### Detailed agricultural land classification

- 2.3.3 One hundred and forty five archived auger bores from Cranfield University were used in this ALC assessment. No additional field surveys were carried out in this CFA.
- 2.3.4 The principal physical factors influencing agricultural production and land quality in this CFA are climate, site and soil and the interactions between them.
- 2.3.5 Soil profiles were examined using an Edelman (Dutch) auger and a spade. Where soils were stony or dry a 2.5cm diameter screw auger was used to enable deeper penetration. At each observation point the following characteristics were assessed for each soil horizon up to a maximum of 120cm where possible, or to any impenetrable layer:
- soil texture;
  - significant stoniness;
  - colour (including local gley and mottle colours);
  - consistency;
  - structural condition;
  - free carbonate; and
  - depth.
- 2.3.6 Soil available water capacity, relevant to the assessment of drought risk, was estimated from texture, structure, organic matter content, stone content and profile depth.

### Agro-climatic limitations

- 2.3.7 The local climatic factors have been interpolated from the Meteorological Office's database (Met Office 1989) held in the Landis climatic database at Cranfield University<sup>12</sup> at 1km intervals along the line of the track. The average of the parameters is given in Table 3. There is little variation across the CFA: FCDs are within the narrow range 138 to 143 days; average annual rainfall (AAR) is from 641mm to 662mm; moisture deficits are 100mm to 105mm for wheat and 89mm to 96mm for potatoes.

Table 3: Interpolated agro-climatic data

Climatic parameter	SP3769 6462 Welsh Road crossing	SP3572 6761 River Leam crossing	SP3489 6890 B4453 crossing
Altitude (m)	75	62	95
Average annual rainfall (mm)	652	641	662
Accumulated Temperature >0°C (Jan-June)	1405	1419	1381

<sup>12</sup> <http://archive.defra.gov.uk/foodfarm/landmanage/land-use/documents/alc-guidelines-1988.pdf> Accessed Aug 2103.

Climatic parameter	SP3769 6462 Welsh Road crossing	SP3572 6761 River Leam crossing	SP3489 6890 B4453 crossing
Field Capacity Days (days)	138	138	143
Average Moisture Deficit, wheat (mm)	104	105	100
Average Moisture Deficit, potatoes (mm)	95	96	89

- 2.3.8 Climate itself does not place any limitation upon the land in this part of the West Midlands, but the interactions of climate with soil characteristics are important in determining the wetness and droughtiness limitations of the soil.
- 2.3.9 The influence of climate on soil wetness is assessed by reference to median Field Capacity Days (FCD) when the soil moisture deficit is zero, soil wetness class (WC) and topsoil texture (Table 6, ALC Guidelines, 1988)<sup>10</sup>. Soil WC was inferred from the matrix colour, presence or absence of, and depth to, greyish and ochreous gley mottling and/or poorly permeable subsoil layers at least 15cm thick.
- 2.3.10 The ALC grade according to soil wetness was determined by following the methodology set out in the ALC Guidelines (October, 1988)<sup>10</sup> and the information in the Table 4.

Table 4: ALC grade according to soil wetness – mineral soils (From Table 6 of ALC Guidelines, October 1988)<sup>10</sup>

Wetness class	Texture <sup>1</sup> of the top 25cm	Field capacity days				
		<126	126-150	151-175	176-225	>225
I	S <sup>2</sup> LS <sup>3</sup> SL SZL	1	1	1	1	2
	ZL MZCL MCL SCL	1	1	1	2	3a
	HZCL HCL	2	2	2	3a	3b
	SC ZC C	3a(2)	3a(2)	3a	3b	3b
II	S <sup>2</sup> LS <sup>3</sup> SL SZL	1	1	1	2	3a
	ZL MZCL MCL SCL	2	2	2	3a	3b
	HZCL HCL	3a(2)	3a(2)	3a	3a	3b
	SC ZC C	3a(2)	3b(3a)	3b	3b	3b
III	S <sup>2</sup> LS SL SZL	2	2	2	3a	3b
	ZL MZCL MCL SCL	3a(2)	3a(2)	3a	3a	3b
	HZCL HCL	3b(3a)	3b(3a)	3b	3b	4
	SC ZC C	3b(3a)	3b(3a)	3b	4	4
IV	S <sup>2</sup> LS SL SZL	3a	3a	3a	3b	3b
	ZL MZCL MCL SCL	3b	3b	3b	3b	3b
	HZCL HCL	3b	3b	3b	4	4
	SC ZC C	3b	3b	3b	4	5

Wetness class	Texture <sup>1</sup> of the top 25cm	Field capacity days				
		<126	126-150	151-175	176-225	>225
V	S LS SL SZL	4	4	4	4	4
	ZL MZCL MCL SCL	4	4	4	4	4
	HZCL HCL	4	4	4	4	4
	SC ZC C	4	4	4	5	5

Soils in Wetness Class VI – Grade 5

Texture key: S – sand; LS – loamy sand; SL – sandy loam; SZL – sandy silt loam; ZL – silt loam; MZCL – medium silty clay loam; MCL – medium clay loam; SCL – sandy clay loam; HZCL – heavy silty clay loam; HCL – heavy clay loam; SC – sandy clay; ZC – silty clay; C – clay

<sup>1</sup> For naturally calcareous soils with more than 1% CaCO<sub>3</sub> and between 18% and 50% clay in the top 25cm, the grade, where different from that of other soils, is shown in brackets.

<sup>2</sup> Sand is not eligible for Grades 1, 2 or 3a.

<sup>3</sup> Loamy sand is not eligible for Grade 1.

- 2.3.11 Droughtiness is determined by comparing crop-adjusted available water (AP), with the moisture deficit (MD) for the locality for wheat and potatoes (MAFF 1988 Appendix 4). Grading of the land can be affected if the AP is insufficient to balance the MD and droughtiness occurs. The availability of irrigation can improve grading by one division where appropriate. However, irrigation is not common practice for grass cereals and oil seed rape (OSR). The calculation used in the ALC Guidelines (October, 1988)<sup>10</sup> to determine the severity of this limitation is given below in Figure 1.

### Site limitations

- 2.3.12 The assessment of site limitations is primarily concerned with the way in which topography influences the use of agricultural machinery and hence the cropping potential of land. Gradient and microrelief<sup>13</sup> are not considered limiting in this CFA.
- 2.3.13 Flooding is limited to the floodplains of the River Leam through the centre of the CFA and its tributaries, and the valley occupied by the Grand Union Canal in the south. This is a potential limitation but its incidence is difficult to ascertain. Flood risk is determined by the extent, duration, frequency and timing of flooding events which may not have been recorded. The published flood maps by the Environment Agency can be used as a guide (see Figure WR-05-17, Volume 5) and the annual flood risk is not considered sufficient to be a limiting factor in this CFA.

### Soil limitations

- 2.3.14 The main soil properties which affect the cropping potential and management requirements of land are texture, structure, depth, stoniness, chemical fertility and topography. Together they influence the functions of soil and affect the water availability for crops, drainage, workability and trafficability. The main soil characteristics within the CFA are sandy loam and sandy textures in river terrace drifts and on Bromsgrove Sandstone; medium and heavy clay loam over clayey textures, commonly with poor subsoil structure and slow permeability, over Mercia Mudstone and till; clayey textures in some shallow soils on mudstone and in alluvial soils in the valley bottoms with fluctuating groundwater. Limitations imposed by soil depth, chemistry and topography are not encountered.

<sup>13</sup> Complex changes of slope angle and direction over short distances or the presence of boulders or rock outcrops, even on level or gentle slopes, which can severely limit the use of agricultural machinery.

Figure 1: Methodology for calculating the severity of a droughtiness limitation to ALC grading (derived from MAFF, 1988)

$$AP \text{ wheat (mm)} = \frac{TA_{vt} \times LT_t + \sum (TA_{vs} \times LT_{50}) + \sum (EA_{vs} \times LT_{50-120})}{10}$$

where

$TA_{vt}$  is Total available water ( $TA_v$ ) for the topsoil texture

$TA_{vs}$  is Total available water ( $TA_v$ ) for each subsoil layer

$EA_{vs}$  is Easily available water ( $EA_v$ ) for each subsoil layer

$LT_t$  is thickness (cm) of topsoil layer

$LT_{50}$  is thickness (cm) of each subsoil layer to 50 cm depth

$LT_{50-120}$  is thickness (cm) of each subsoil layer between 50 and 120 cm depth

$\Sigma$  means 'sum of'.

$$AP \text{ potatoes (mm)} = \frac{TA_{vt} \times LT_t + \sum (TA_{vs} \times LT_{70})}{10}$$

where

$LT_{70}$  is thickness (cm) of each subsoil layer to 70 cm depth

**MB (Wheat) = AP (Wheat) - MD (Wheat)**

**MB (Potatoes) = AP (Potatoes) - MD (Potatoes)**

Where

MB is the Moisture Balance

AP is the Crop-adjusted available water capacity

MD is the moisture deficit, as determined by the agro-climatic assessment.

**Table 8      Grade according to droughtiness**

Grade/ Subgrade	Moisture Balance limits (mm)		
	<i>wheat</i>		<i>potatoes</i>
1	+30	<i>and</i>	+10
2	+5	<i>and</i>	-10
3a	-20	<i>and</i>	-30
3b	-50	<i>and</i>	-55
4	<-50	<i>or</i>	<-55

### Interactive limitations

- 2.3.15 The physical limitations which result from interactions between climate, site and soil are soil wetness, droughtiness and erosion. Each soil can be allocated a Wetness Class (WC) based on soil structure, evidence of waterlogging and the number of Field Capacity Days; where soil droughtiness is not a problem the topsoil texture and stone content then determines its ALC Grade. Deep sandy loam and sandy soils of the Wick 1 association are permeable and largely well drained (WC I) or have slight seasonal waterlogging (WC II) where affected by fluctuating groundwater, and in both cases are without a wetness limitation. Land with soils typical of the Hodnet and Whimple 3

associations with a medium clay loam topsoil are limited to Grade 2 if in WC II, or to Subgrade 3a if in WC III. Seasonally waterlogged soils (WC III) of the Brockhurst 1 and Salop associations are limited to Subgrade 3a where the topsoil is medium clay loam, but Subgrade 3b where heavy clay loam; in wetter situations (WC IV) both medium and heavy clay loam topsoil textures limit the land to Subgrade 3b. Worcester and Fladbury soils, in WC III and with heavy clay loam or clayey topsoils, are limited to 3b.

- 2.3.16 Soil texture, stone content and structure determine the available water capacity of the soil profile. When calculated against the demands of a growing wheat and potato crop in the locality given by the climatic variable, the moisture deficit, a moisture balance is produced from which a droughtiness limitation can be assessed. The clay loam over clay soils of the Hodnet, Whimble 3, Brockhurst 1 and Salop associations and the clays of the Worcester association have sufficient moisture reserves in an average year to have no droughtiness limitation, or only one that limits the land to Grade 2; sandy loam soils of the Wick 1 association, however, tend to have a smaller available water capacity. Dominantly sandy loam soils limit the land to Grade 2 or Subgrade 3a depending on the stone content, and sandy soils are Subgrade 3a or 3b, again depending on the stone content. Where irrigation facilities are available, and it is a current or recent practice, this is taken into account and may raise the Grade as the potential range and yield of crops (particularly horticultural and root crops) is increased.
- 2.3.17 The combined MAGIC detailed surveys and this project's survey allow an improved ALC assessment.
- 2.3.18 Grade 2 land occurs on the sandy loam soils of Wick 1 association and some lighter textured, better drained soils of the Hodnet and Whimble 3 associations with slowly permeable subsoils.
- 2.3.19 Where soil wetness is accompanied by heavier topsoil textures, these features become the main limitation restricting the range of crops. Within the Hodnet and Whimble 3 associations, the limitation for the lead soils is only moderate in an area with FCD values of 138 to 143 days and the land is allocated to Subgrade 3a.
- 2.3.20 Also within these associations, and within the dominant seasonally waterlogged soils of the Brockhurst and Salop associations, where the wetness/texture limitation is more restrictive and the safe working period shorter, the land is classed as Subgrade 3b. Within the Worcester association the heavy clay loam or clayey topsoil limits the lead series to Subgrade 3b. Agricultural land occupying floodplains, including Fladbury association, has also been assessed as Subgrade 3b.

### **Summary of ALC assessment in CFA17**

- 2.3.21 The characteristics of the soil series encountered within each association and a summary of the key characteristics relevant to the ALC grading in CFA17 are given in Table 5 to Table 11.

Table 5: Worcester Association (431)

Reddish clayey soils with slowly permeable subsoils and seasonal waterlogging. Some similar clayey and loamy over clayey soils with slight seasonal waterlogging.

Main soil series	Ancillary soil series occurring locally	Geology	Average field capacity days (max 143 min 138)	Wetness class	Average moisture deficit and (available water) mm		ALC grade	ALC determinant
					Wheat	Potatoes		
Worcester		Mercia Mudstone Group	140	III	102 (115)	93 (100)	3b	Topsoil texture and wetness class
	Whimble	Mercia Mudstone Group	140	II-III	102 (120)	93 (105)	2 or 3a	Topsoil texture and wetness class
	Clayworth	Mercia Mudstone Group	140	III	102 (115)	93 (100)	3b	Topsoil texture and wetness class

**Brief Soil Profile Descriptions**

Worcester	Whimble	Clayworth
0-25cm Ap: Dark brown, very slightly stony heavy clay loam or clay  25-50cm Bt(g): Reddish brown stoneless silty clay or clay; strong coarse angular blocky structure  50-100cm BCt(g): Reddish brown stoneless silty clay or clay; strong coarse prismatic structure  At 100cm Cr: Reddish mudstone	0-25cm Ap: Dark brown slightly stony medium clay loam  25-40cm Eb(g): Reddish brown, slightly mottled, slightly stony clay loam; moderate medium subangular blocky structure  40-60cm Bt(g): Reddish brown, slightly mottled, slightly stony clay loam; moderate to coarse prismatic structure  60-100cm 2BCtg: Reddish brown, mottled, stoneless clay; coarse prismatic structure  At 100cm Cr: Reddish mudstone	0-25cm Ap: Dark brown, stoneless clay  25-50cm Bw(g): Reddish brown stoneless clay; strong coarse prismatic structure; calcareous  50-75cm BCK(g): Reddish brown stoneless or slightly stony clay or silty clay loam; strong coarse prismatic structure; very calcareous  75-100cm Cr: Yellowish red, moderately stony clay to silty clay loam; massive; very calcareous



## Appendix AG-001-017 | Soils and agricultural land classification surveys

Table 6: Wick Association (541r)

Deep well drained sandy loam and sandy soils, locally over gravel; some similar soils affected by groundwater.

Main soil series	Ancillary soil series occurring locally	Geology	Average field capacity days (max 143 min 138)	Wetness class	Average moisture deficit and (available water) mm		ALC grade	ALC determinant
					Wheat	Potatoes		
Wick		Glaciofluvial sands and gravels and river terrace	140	I	102 (110-100)	93 (90-80)	2 or 3a*	Droughtiness
	Arrow	Glaciofluvial sands and gravels and river terrace	140	II	102 (110-100)	93 (90-80)	2 or 3a*	Droughtiness
	Newport	Glaciofluvial sands and gravels and river terrace	140	I	102 (100-85)	93 (80-65)	2 or 3a*	Droughtiness

\* Where subsoil texture is loamy sand and or stone content is moderate to high then grade is restricted to 3a by drought.

### Brief Soil Profile Descriptions

Wick	Arrow	Newport
<p>0-25cm Ap: Dark brown, slightly stony sandy loam</p> <p>25-50cm Bw1: Dark yellowish brown, slightly to moderately stony sandy loam; moderate to weak medium subangular blocky structure</p> <p>50-80cm Bw2: Yellowish brown slightly or moderately stony sandy loam or loamy sand; weak medium angular blocky structure or single grain</p> <p>80-120cm Cu: Brownish yellow, slightly or moderately stony loamy sand or sandy loam; single grain structure</p>	<p>0-25cm Ap: Dark brown, slightly stony sandy loam</p> <p>25-50cm Bw: Dark yellowish brown, slightly to moderately stony sandy loam; weak medium subangular blocky structure</p> <p>50-80cm Bw(g): Brown, slightly mottled, slightly or moderately stony sandy loam or loamy sand; weak coarse subangular blocky structure</p> <p>80-120cm BCg: Brownish yellow, mottled, slightly or moderately stony loamy sand or sandy loam; single grain structure</p>	<p>0-25cm Ap: Dark brown, slightly stony sandy loam or loamy sand</p> <p>25-55cm Bw: Brown, slightly stony loamy sand; weak fine subangular blocky structure</p> <p>55-120cm Cu: Yellowish red or brownish yellow slightly or moderately stony loamy sand or sand; single grain structure</p>

Table 7: Hodnet Association (572c)

Reddish clay loam and sandy loam soils with slowly permeable subsoils and slight seasonal waterlogging. Some similar well drained reddish fine loamy soils.

Main soil series	Ancillary soil series occurring locally	Geology	Average field capacity days (max 143 min 138)	Wetness class	Average moisture deficit and (available water) mm		ALC grade	ALC determinants
					Wheat (max 105 min 99)	Potatoes (max 97 min 89)		
Hodnet		Mercia Mudstone Group	140	II	102 (120)	93 (105)	2 or 3a	Topsoil texture and wetness class
	Whimble	Mercia Mudstone Group	140	II-III	102 (120)	93 (105)	2 or 3a	Topsoil texture and wetness class
	Dunnington Heath	Thin drift over Mercia Mudstone Group	140	II-III	102 (115)	93 (100)	1 or 2	Topsoil texture and wetness class

**Brief Soil Profile Descriptions**

Hodnet	Whimble	Dunnington Heath
<p>0-25cm Ap: Dark reddish brown, very slightly stony sandy silt loam or clay loam</p> <p>25-35cm Eb: Reddish brown, very slightly stony sandy silt loam or clay loam; weak coarse subangular blocky structure</p> <p>35-60cm Bt(g): Reddish brown, mottled, stoneless or slightly stony clay loam; moderate prismatic or angular blocky structure</p> <p>60-100cm Cg: Dark reddish brown, clay loam; massive structure</p> <p>100-120cm Cr: Reddish brown silty shale and sandstone</p>	<p>0-25cm Ap: Dark brown slightly stony medium clay loam</p> <p>25-40cm Eb(g): Reddish brown, slightly mottled, slightly stony medium clay loam; moderate medium subangular blocky structure</p> <p>40-60cm Bt(g): Reddish brown, slightly mottled, slightly stony clay loam; moderate to coarse prismatic structure</p> <p>60-100cm 2BCtg: Reddish brown, mottled, stoneless clay; coarse prismatic structure</p> <p>At 100cm Cr: Reddish mudstone</p>	<p>0-25cm Ap: Dark brown, slightly stony sandy loam</p> <p>25-55cm Eb: Brown, slightly stony sandy loam; weak medium subangular blocky structure</p> <p>55-85cm 2Btg: Reddish brown, stoneless clay weak coarse prismatic structure</p> <p>85-100cm BCg: Reddish brown, mottled, stoneless clay; massive structure</p>

## Appendix AG-001-017 | Soils and agricultural land classification surveys

Table 8: Whimble 3 Association (572f)

Reddish loamy over clayey soils with slowly permeable subsoils and slight seasonal waterlogging. Some similar clayey soils on brows and slowly permeable, seasonally waterlogged soils on lower slopes.

Main soil series	Ancillary soil series occurring locally	Geology	Average field capacity days (max 143 min 138)	Wetness class	Average moisture deficit and (available water) mm		ALC grade	ALC determinants
					Wheat	Potatoes		
Whimble*		Mercia Mudstone Group	140	II-III	102 (120)	93 (105)	2 or 3a	Topsoil texture and wetness class
	Worcester	Mercia Mudstone Group	140	III	102 (115)	93 (100)	3b	Topsoil texture and wetness class
	Brockhurst	Mercia Mudstone Group	140	III	102 (115)	93 (100)	3a or 3b**	Topsoil texture and wetness class

\* Dunnington Heath series is a local inclusions in this association.

\*\* Where the topsoil texture is heavy clay loam, the Subgrade is 3b.

### Brief Soil Profile Descriptions

Whimble	Worcester	Brockhurst
<p>0-25cm Ap: Dark brown slightly stony clay loam</p> <p>25-40cm Eb(g): Reddish brown, slightly mottled, slightly stony clay loam; moderate medium subangular blocky structure</p> <p>40-60cm Bt(g): Reddish brown, slightly mottled, slightly stony clay loam; moderate to coarse prismatic structure</p> <p>60-100cm 2BCtg: Reddish brown, mottled, stoneless clay; coarse prismatic structure</p> <p>At 100cm Cr: Reddish mudstone</p>	<p>0-25cm Ap: Dark brown, very slightly stony heavy clay loam or clay</p> <p>25-50cm Bt(g): Reddish brown stoneless silty clay or clay; strong coarse angular blocky structure</p> <p>50-100cm BCt(g): Reddish brown stoneless silty clay or clay; strong coarse prismatic structure</p> <p>At 100cm Cr: Reddish mudstone</p>	<p>0-20cm Ap: Dark brown very slightly stony medium or heavy clay loam</p> <p>20-40cm Eg: Brown, mottled slightly stony medium or heavy clay loam; moderate medium subangular blocky structure</p> <p>40-75cm Btg: Reddish brown, mottled stoneless or very slightly stony clay; strong coarse prismatic structure</p> <p>75-100cm BCtg: Reddish brown mottled stoneless clay moderate coarse prismatic structure</p> <p>At 100cm Cr: Reddish mudstone</p>

Table 9: Brockhurst 1 Association (711b)

Slowly permeable seasonally waterlogged reddish loamy over clayey soils. Some similar soils with slowly permeable subsoils and slight seasonal waterlogging.

Main soil series	Ancillary soil series occurring locally	Geology	Average field capacity days (max 143 min 138)	Wetness class	Average moisture deficit and (available water) mm		ALC grade	ALC determinants
					Wheat	Potatoes		
Brockhurst		Mercia Mudstone Group	140	III	102 (115)	93 (100)	3a or 3b*	Texture and wetness
	Salop	Till,	140	III	102 (115)	93 (100)	3a or 3b*	Texture and wetness
	Whimble	Mercia Mudstone Group	140	II-III	102 (120)	93 (105)	2** or 3a	Texture and wetness

\* Where Subgrade is 3b the topsoil texture is heavy clay loam.

\*\* Grade 2 where WC II.

#### Brief Soil Profile Descriptions

Brockhurst	Salop	Whimble
<p>0-20cm Ap: Dark brown very slightly stony medium or heavy clay loam</p> <p>20-40cm Eg: Brown, mottled slightly stony medium or heavy clay loam; moderate medium subangular blocky structure</p> <p>40-75cm Btg: Reddish brown, mottled stoneless or very slightly stony clay; strong coarse prismatic structure</p> <p>75-100cm BCtg: Reddish brown mottled stoneless clay moderate coarse prismatic structure</p> <p>At 100cm Cr: Reddish mudstone</p>	<p>0-25cm Ap: Very dark greyish brown slightly stony medium or heavy clay loam</p> <p>25-45cm Eg: Brownish grey, mottled, slightly medium or heavy stony clay loam; moderate medium subangular blocky structure</p> <p>45-100cm Btg: Yellowish red, mottled, slightly stony; moderate to weak coarse prismatic structure</p> <p>100-120cm BCtg: Reddish brown, mottled, slightly stony clay; massive structure</p>	<p>0-25cm Ap: Dark brown slightly stony medium clay loam</p> <p>25-40cm Eb(g): Reddish brown, slightly mottled, slightly medium stony clay loam; moderate medium subangular blocky structure</p> <p>40-60cm Bt(g): Reddish brown, slightly mottled, slightly medium or heavy stony clay loam; moderate to coarse prismatic structure</p> <p>60-100cm 2BCtg: Reddish brown, mottled, stoneless clay; Coarse prismatic structure</p> <p>At 100cm Cr: Reddish mudstone</p>

## Appendix AG-001-017 | Soils and agricultural land classification surveys

Table 10: Salop Association (711m)

Slowly permeable seasonally waterlogged reddish loamy over clay, loamy and clayey soils, associated with similar soils with only slight seasonal waterlogging.

Main soil series	Ancillary soil series occurring locally	Geology	Average field capacity days (max 143 min 138)	Wetness class	Average moisture deficit and (available water) mm		ALC grade	ALC determinants
					Wheat	Potatoes		
Salop*		Oadby till	140	III	102 (115)	93 (100)	3a or 3b**	Topsoil texture and wetness class
	Clifton	Oadby Till and glaciofluvial sands and gravels	140	III	102 (125)	93 (105)	3a or 3b**	Topsoil texture and wetness class
	Flint	Oadby Till	140	II-III	102 (115)	93 (100)	2 or 3a	Topsoil texture and wetness class

\* Locally inclusions of clay soils are similar to Crewe series. Astley Hall series common on lower slopes and valley bottoms.

\*\* Where Subgrade is 3b the topsoil texture is heavy clay loam.

### Brief Soil Profile Descriptions

Salop	Clifton	Flint
0-25cm Ap: Very dark greyish brown slightly stony clay loam	0-25cm Ap: Dark greyish brown slightly stony clay loam or sandy clay loam	0-25cm Ap: Dark brown, slightly stony clay loam
25-45cm Eg: Brownish grey, mottled, slightly stony clay loam; moderate medium subangular blocky structure	25-35cm Eg: Greyish brown, mottled slightly stony clay loam or sandy clay loam; weak medium subangular blocky structure	25-60cm EBg: Brown, slightly mottled, slightly or moderately stony; clay loam moderate medium subangular blocky structure
45-100cm 2Btg: Yellowish red, mottled, slightly stony; clay, moderate to weak coarse prismatic structure	35-80cm Btg: Reddish brown, mottled, slightly stony clay loam or sandy clay loam; moderate coarse prismatic structure	60-100cm Btg: Reddish brown, mottled, slightly stony clay strong coarse angular blocky or prismatic structure
100-120cm BCtg: Reddish brown, mottled, slightly stony clay; massive structure	80-120cm BCtg: Reddish brown mottled slightly stony clay loam; weak coarse prismatic or massive structure	100-120cm BCtg: Reddish brown, mottled slightly to moderately stony clay; massive structure

Table 11: Fladbury 1 Association (813b)

Stoneless clayey soils, in places calcareous, on floodplains and variably affected by groundwater.

Main soil series	Ancillary soil series occurring locally	Geology	Average field capacity days (max 143 min 138)	Wetness class	Average moisture deficit and (available water) mm		ALC grade	ALC determinants
					Wheat	Potatoes		
Fladbury		Alluvium	140	III-IV	102 (130)	93 (110)	3b	Topsoil texture and wetness class
	Wyre	Alluvium	140	II	102 (130)	93 (110)	2 or 3a	Topsoil texture and wetness class
	Thames	Alluvium	140	III	102 (130)	93 (110)	3a or 3b*	Topsoil texture and wetness class

\* Subgrade 3b where non calcareous in the topsoil.

#### Brief Soil Profile Descriptions

Fladbury	Wyre	Thames
<p>0-20cm Ap: Dark greyish brown stoneless clay</p> <p>20-60cm Bg: Greyish brown with many ochreous mottles, stoneless clay; strong coarse prismatic structure</p> <p>60-100cm Cg: Grey mottled, stoneless clay; moderate angular blocky or massive structure</p>	<p>0-25cm Ap: Dark brown stoneless clay</p> <p>25-45cm Bw: Yellowish brown, stoneless clay; strong medium angular blocky structure</p> <p>45-100cm Bg: Greyish brown with many ochreous mottles, stoneless clay; strong coarse angular blocky or prismatic structure</p>	<p>0-20cm Ap: Dark greyish brown, slightly mottled, stoneless clay; calcareous or non-calcareous</p> <p>20-30cm Bg1: Greyish brown with many ochreous mottles, stoneless clay; strong coarse subangular blocky structure; calcareous</p> <p>30-60cm Bg2: Greyish brown with many ochreous mottles, stoneless clay; moderate coarse prismatic structure; calcareous</p> <p>60-100cm BCg: Grey mottled, stoneless clay; moderate coarse prismatic structure</p>

### 3 Forestry

- 3.1.1 Identification of forestry resources has primarily had regard to the National Forestry Inventory<sup>14</sup>.
- 3.1.2 The area of land under forestry (i.e. trees and woodland) within 2km either side of the route centre line has been determined using GIS and is shown in Table 12.

Table 12: Area of woodland within the study area and construction boundary

	Area of forestry land (ha)	Forestry land as a % of total land area
Forestry land in study area	242.5	9
Forestry land within construction boundary	10.7	6

- 3.1.3 Woodland represents 9% of land cover in this CFA, which is close to the national average of 10%. This includes a large block of woodland in the northern end of the area called South Cubbington Wood. In addition, there is a small parcel of woodland called Burnt Firs and a narrow parcel of woodland (Ash Beds) flanking a tributary of the River Leam. As the cover of forestry land is between 6% and 10%, the sensitivity of the forestry land resource in this study area is considered to be medium, as set out in the SMR Addendum (see Volume 5: Appendix CT-001-000/2).

<sup>14</sup> Forestry Commission (2001), National Forest Inventory Woodland and Ancient Woodland (as updated).

## 4 Assessment of effects on holdings

- 4.1.1 The effects on holdings have been assessed according to the methodology set out in Technical Note AG5 (within Appendix CT-001-000/2). The nature of impacts considered comprises the temporary and permanent land required from the holding, the temporary and permanent severance of land, the permanent loss of key farm infrastructure and the imposition of disruptive effects (particularly noise and dust) on land uses and the holding's operations. These impacts occur primarily during the construction phase of the Proposed Scheme.

Table 13: Summary of assessment of effect on holdings

Holding reference, name and description	Temporary Effects	Permanent Effects
CFA17/1 – Burnt Heath Farm	<p>Land take: 25.6ha; 5% of holding required for construction</p> <p>Severance: mitigated partially by access under Long Hole viaduct, but access will also be necessary off Fosse Way and Welsh Road</p> <p>Disruptive effects: None</p>	<p>Land take: 56.6ha; 11% of holding taken</p> <p>Severance: mitigated partially by access under Long Hole viaduct, but access will also be necessary off Fosse Way and Welsh Road</p> <p>Infrastructure: None affected</p>
CFA17/2 – Fosse Farm	<p>Land take: 5.8ha; 3% of holding required for construction</p> <p>Severance: severed fields can be accessed off Hunningham Road</p> <p>Disruptive effects: None</p>	<p>Land take: 12.1ha; 7 % of holding taken. Land in close proximity to farm buildings</p> <p>Severance: severed fields can be accessed off Hunningham Road</p> <p>Infrastructure: None affected</p>
CFA17/3 – Manor Farm	<p>Land take: 0.0ha; 0% of holding required for construction</p> <p>Severance: severed woodland can be accessed off public highway</p> <p>Disruptive effects: potential loss of rental income from Fields Farm (CFA17/5) may also impact of the profitability of this holding.</p>	<p>Land take: 4.8ha; 17% of holding taken</p> <p>Severance: severed woodland can be accessed off public highway</p> <p>Infrastructure: None affected</p>
CFA17/5 – Fields Farm	<p>Land take: 12.1ha; 9% of holding required for construction</p> <p>Severance: mitigated by access under Leam viaduct</p> <p>Disruptive effects: None</p>	<p>Land take: 18.7ha; 14% of holding taken. Land in close proximity to farm buildings</p> <p>Severance: : mitigated by access under Leam viaduct</p> <p>Infrastructure: None affected</p>
CFA17/6 Lower Grange Farm	<p>Land take: 9.6ha; 3% of holding required for construction</p> <p>Severance: mitigated partially by access via Mill Lane and off Rugby Road.</p> <p>Disruptive effects: None</p>	<p>Land take: 41.0ha; 11% of holding taken</p> <p>Severance: mitigated partially by access via Mill Lane and off Rugby Road.</p> <p>Infrastructure: None affected</p>



Appendix AG-001-017 | Assessment of effects on holdings

Holding reference, name and description	Temporary Effects	Permanent Effects
CFA17/7 – Weston Hall Farm	<p>Land take: 0.2ha; 0% of holding required for construction</p> <p>Severance: mitigated by access off Mill Lane</p> <p>Disruptive effects: None</p>	<p>Land take: 14.8ha; 5% of holding taken. Land in close proximity to farm buildings</p> <p>Severance: mitigated by access off Mill Lane</p> <p>Infrastructure: None affected</p>
CFA17/9 – Land adjacent to Leicester Lane	<p>Land take: 0.0ha; 0% of holding required for construction</p> <p>Severance: None</p> <p>Disruptive effects: None</p>	<p>Land take: 0.1ha; 1% of holding taken. Land in close proximity to farm buildings</p> <p>Severance: None</p> <p>Infrastructure: None affected</p>
CFA17/10 – Oakdene	<p>Land take: 0.0ha; 0% of holding required for construction</p> <p>Severance: None</p> <p>Disruptive effects: None</p>	<p>Land take: 0.1ha; 1% of holding taken</p> <p>Severance: None</p> <p>Infrastructure: None affected</p>

\* No farm impact assessment interview conducted; data estimated.

## 5 References

British Geological Survey. <http://bgs.ac.uk/geologyofbritain/home/html>.

Cranfield University (2001), *The National Soil Map of England and Wales* 1:250,000 scale.

Department for Environment, Food and Rural Affairs (Defra) (2005), *Likelihood of Best and Most Versatile Agricultural Land* (1:250,000).

Forestry Commission (2001), *National Forest Inventory Woodland and Ancient Woodland (as updated)*.

Meteorological Office (1989), *Gridpoint Meteorological data for Agricultural Land Classification of England and Wales and other Climatological Investigations*.

Ministry of Agriculture, Fisheries and Food (MAFF) (1983), *Agricultural Land Classification of England and Wales* (1:250,000).

Ministry of Agriculture, Fisheries and Food (MAFF) (1988), *Agricultural Land Classification of England and Wales – Revised guidelines and criteria for grading the quality of agricultural land*.

MAGIC website <http://magic.defra.gov.uk/website/magic/viewer.htm>.

Munsell Color Charts (2000), Munsell Color, Grand Rapids, MI, USA.

Ragg, J.M., Beard, G.R., George, H., Heaven, F.W., Hollis, J.M., Jones, R.J.A., Palmer, R.C., Reeve, M.J., Robson, J.D. and Whitfield, W.A.D., 1984, *Soils and their Use in Midland and Western England*, Soil Survey of England and Wales Bulletin No. 12, Harpenden.

Whitfield, William, (1974). *Soils in Warwickshire I; SP36 (Leamington Spa)*. Rothamsted Experimental Station.